DRAFT REVIEW OF CALIFORNIA COASTAL EROSION PLANNING AND RESPONSE: A STRATEGY FOR ACTION

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California Resources Agency

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EXECUTIVE SUMMARY

California's coastline is an extraordinary natural resource of significant economic, environmental, recreational, and aesthetic value. This spectacular coastline includes sandy beaches, sheer bluffs, rocky headlands, intertidal zones, and other diverse shoreline types. Erosion along the California coast is a natural process. However, this natural process has been considerably affected by human activities such as construction along the shore that has, in many cases, substantially altered the natural movement of sand. In addition, urbanization and modifications to watersheds have drastically reduced the natural supply of sediment to the coastline. There is a compelling need to adopt and implement clear and consistent coastal erosion policies to protect the state's substantial resources along the coast.

California needs a comprehensive, coordinated and proactive approach to coastal erosion, as emphasized by numerous factors:

- ***The coast is actively eroding.***
- ***Natural sand supply to beaches has decreased.***
- ***Storm activity alters the coast.***
- ***Coastal population continues to increase.***
- ***Natural processes and human activities do not respect political boundaries.***

Historic Trends

In many places where the California coastline is actively eroding, substantial economic losses have occurred. The storms of January 1988 and the El Niño winters of 1977-78, 1982-83 and 1997-98 are the most notable in recent history for intensity and widespread damage. The 1982-83 El Niño episode, the strongest ever recorded in California, caused over $116 million in coastal losses, destroyed 33 homes, damaged another 3000 homes and 900 businesses, and caused $35 million in damages to public recreational facilities (Flick and Cayan 1984). Many of these costs to public and private property owners could have been greatly reduced if development was not sited in areas of high geologic hazard, thereby reducing the call for government relief and expensive remediation.

The Economics of Beaches and Other Ocean-Dependent Industries

An economic analysis conducted by the California Research Bureau for the Resources Agency determined that ocean-dependent tourism directly and indirectly contributed $9.9 billion to the State's economy in 1992. A study prepared for the California Department of Boating and Waterways by the Public Research Institute (PRI) reports that residents and out-of-state visitors made over 565 million visits to the state's ocean beaches during 1995 alone (King and Potepan 1997). Another PRI report found that direct spending at beaches, through both tourism and recreation, contributed over $14 billion to the state's economy in 1998 (King 1999).

Other Values Related to Beaches

The benefits of California's beaches are numerous and include the recreational and aesthetic values of a wide sandy beach, the considerable contribution of beaches to the economy, the habitats provided for beach dependent life, and the benefits of beaches for access to the sea.

New Approaches to Addressing Coastal Erosion

State and federal agencies frequently implement strategies for reducing coastal erosion and protecting coastal development on a case-by-case basis. However, the natural processes and human activities that influence coastal erosion and beach loss do not follow political jurisdictional boundaries. A regional approach to addressing coastal erosion and the reduction in sand supply, based on coastal watershed and littoral cell (a portion of coastline where sand flows in, along, and then out of an area) boundaries, is most effective in the long-term. Coordination of federal, state, and local agency activities will be necessary to support such regional approaches

A Strategy for Action

The State of California is committed to conserving, restoring and enhancing California's coastline and beaches. Coastal erosion and beach loss are not issues that can be adequately addressed at only the land and sea interface; effective solutions require a comprehensive statewide approach that considers watersheds that ultimately flow to the ocean, flood control systems, ports, wetlands, beaches and nearshore ocean processes. California must move beyond a policy of case-by-case reviews of coastal erosion projects (often in crisis situations) to an approach that proactively focuses on larger scale regional issues at both the coastline and within associated watersheds.

Government responsibility for addressing coastal erosion and beach loss in particular is divided among a host of federal, state, and local agencies. Other interested parties range from private property owners and businesses to public interest groups and academia. Cooperation among these parties will be necessary to implement an effective coastal erosion planning and response action plan. This Draft Strategy recommends a strategy for action based on the systematic pursuit of either a multi-agency rulemaking process, an executive order, or new legislation. Independent of the method chosen for implementation, three specific actions are recommended.

Recommendation 1: Adopt Five General Principles

The State of California should adopt as state policy a set of five general principles for addressing coastal erosion, in order of preference:

- ***Hazard Avoidance for New or Modified Development.*** Avoid development in coastal areas of high geologic hazard.

- ***Maintaining Natural Sources of Sediment to the Coast.*** Reduce or eliminate barriers to natural sources of sand leading from coastal watersheds to beaches and whenever feasible seek to re-establish sand flow currently restricted by dams or other structures.

- ***Regional Beach Nourishment.*** Where feasible, use a regional program of sand nourishment (placing sand on or near beaches) to protect existing shoreline development or recreational features.

- ***Relocating or Eliminating Coastal Development Where Feasible.*** Move development threatened by coastal erosion to safer ground, if such relocation is feasible.

- ***Hard Protection Devices.*** Consider the construction of hard protection devices (seawalls, revetments, or bulkheads, etc.) for coastal-dependent uses, existing structures, or public beaches in danger from erosion only after all the previous options have been considered and deemed to be infeasible.

Recommendation 2: Amend the California Coastal Act

The State of California should amend the Coastal Act to clarify the use of hard protection devices. The definition and interpretation of the term "existing structure" used in the Coastal Act needs clarification as it relates to the approval of hard protection devices for "existing structures." One approach to address this issue would be to amend the Coastal Act to prohibit or restrict the approval of hard protection devices for "new structures" constructed after a date specified in the statute. This clarification could begin to reduce the construction of new hard protection devices along the California coast.

Recommendation 3: Complete a Coastal Sediment Management Master Plan

The State of California should require the Department of Boating and Waterways, California Coastal Commission, and California Coastal Conservancy, in cooperation with the U.S. Army Corps of Engineers and interested parties, to complete a California Coastal Sediment Management Master Plan (Master Plan) within two years. The Master Plan should provide information for understanding the erosion problems California faces, and identify strategies for the most effective and efficient ways we can begin to address them. The key to developing and implementing this comprehensive approach will be for all levels of government, the public, academia and the private sector to collaborate through an extensive public outreach effort. Among other objectives, this Master Plan should:

- Identify, on a regional basis, the coastal areas most threatened by erosion and other geologic hazards.
- Identify regional strategies for addressing these threatened coastal areas, consistent with the general principals identified above.
- Identify and assess the adequacy of existing legal and planning measures at all levels of government to address these threatened areas, as well as to respond to other sediment management issues in each region.
- Identify, catalogue, and help provide access to relevant information sources for each region.

- Develop clear scientific standards for the beneficial use of sediments to support beaches by evaluating varying oceanographic conditions, necessary sand grain size for beach nourishment, and potential adverse impacts to marine life and their habitats.
- Identify research necessary to apply state-of-the-art methods to address coastal erosion.
- Identify ways to maximize the benefits of California's fiscal participation in addressing coastal erosion.

Moving Forward

This Draft Strategy envisions a comprehensive approach to shoreline erosion never before attempted in the State of California. Establishing clear statewide priorities for approaching California coastal erosion and clarifying certain Coastal Act policies, combined with developing a progressive Coastal Sediment Management Master Plan will help California face future challenges. By necessity this will bring federal, state, and local agencies and other stakeholders together to pursue a common vision, yet there is no panacea presented in these recommendations. New management approaches cannot eliminate sea level rise, El Niño storm activity, or the natural process of sediment movement and erosion along our shoreline. The fact is that there are existing structures and coastal dependent facilities (including some critical infrastructure) currently located in high geologic hazard areas along the California coastline, and tough decisions will have to be made regarding their protection.

Interest in moving forward with this Draft Strategy appears to be significant, based on the volume of written comments received and the interest expressed at workshops conducted at many coastal locations, from Trinidad in Northern California to Encinitas in Southern California. Implementation of the recommendations, when finalized, will be based on the most effective approaches determined to be suitable at that point in time. Irrespective of the method or methods chosen for implementation, ultimate success will depend upon a coordinated and cooperative approach by all interested parties.

DRAFT REVIEW OF CALIFORNIA COASTAL EROSION PLANNING AND RESPONSE: A STRATEGY FOR ACTION

I. INTRODUCTION

California's coastline is an extraordinary natural resource of significant economic, environmental, recreational, and aesthetic value. This spectacular coastline includes sandy beaches, sheer bluffs, rocky headlands, intertidal zones, and other diverse shoreline[1] types. This variation of landforms, combined with many other factors, results in erosion rates that vary from one portion of the coast to another. With sea levels rising steadily for at least the past quarter century and expected to continue in the future, coastal erosion will continue to be an important issue for California.

Erosion along the California coast is a natural process. However, this natural process has been considerably affected by human activities such as construction along the shore that has, in many cases, substantially altered the natural movement of sand. In addition, urbanization and modifications to watersheds have drastically reduced the natural supply of sediment to the coastline.

There is a compelling need to adopt and implement clear and consistent coastal erosion policies to protect the state's substantial resources along the coast. These policies must provide for the maintenance of critical infrastructure and the protection of natural resources, while also considering the dynamic and sometimes unpredictable nature of the state's coastal bluffs, beaches, and sand resources. California needs a comprehensive, coordinated and proactive approach to coastal erosion, as emphasized by numerous factors:

- ***The coast is actively eroding.*** Approximately 85 percent of the California coast is actively eroding due to complex oceanographic and geologic conditions, and human activities that affect the delivery and movement of sand along the coast.

- ***Natural sand supply to beaches has decreased.*** Constructing dams and debris basins, channeling rivers and streams, and covering land areas with hard surfaces have substantially decreased the supply of sediment from watersheds to the coastline. These sediments are the building blocks for California's beaches.

- ***Storm activity alters the coast.*** Storm activity, particularly during El Niño years, alters the configuration of the coast and often causes severe damage to human development. The 1982-83 El Niño episode alone caused over $100 million in damages to public, private and commercial facilities. This storm activity occurs on a periodic basis and is a natural part of California's coastal environment.

[1] For the distinction between "shoreline" and "coastline," see the definitions on page 15. Definitions are also provided for key terms such as "development," "beach," "coast" and "coastal-dependent."

- ***Coastal population continues to increase.*** Since the Resources Agency first issued its ***Policy on Shoreline Erosion Protection*** in 1978, California's population has increased from less than 23 million to over 34 million people. California's coastal counties only comprise approximately 45% of the state's total land area, yet these regions are currently home to approximately 80% of the state's population (California Department of Finance 2001). Added to the 27 million people living in coastal counties are the 32 million annual out-of-state visitors to coastal beaches (King and Potepan 1997), all of whom contribute to increased development and infrastructure in the coastal zone. California's population is expected to increase to over 40 million people by 2010, putting additional development pressure on coastal communities.

- ***Natural processes and human activities do not respect political boundaries.*** The natural processes and human activities contributing to coastal erosion do not recognize jurisdictional boundaries; therefore, comprehensive state guidance and coordinated agency policies are needed to help address these issues.

In recognition of the exceptional environmental, economic and recreational value of our coastal resources, the State of California is committed to conserving, restoring and enhancing California's coastline and beaches. Coastal erosion and beach loss are not issues that can be adequately addressed at only the land and sea interface; effective solutions require a comprehensive statewide approach that considers watersheds that ultimately flow to the ocean, flood control systems, ports, wetlands, beaches and nearshore ocean processes. Potential actions will vary depending upon the physical nature of the stretch of coastline in question and whether it is highly urbanized or a more rural landscape.

California must move beyond a policy of case-by-case reviews of coastal erosion projects (often in crisis situations) to an approach that proactively focuses on larger scale regional issues at both the coastline and within associated watersheds. It is clear that there are no “one size fits all” solutions to address these issues; however, it is equally clear that many similarities and interconnections occur within defined regions. Coastal geologists and engineers have demonstrated that any alteration of sediment transport within a region will likely impact, to some degree, the movement and availability of sand elsewhere within that region. This can result in either positive or negative impacts on coastal resources and development and these impacts must be better understood.

It is time for the State of California to formally adopt a strategy that addresses coastal erosion and beach loss issues and takes the most expeditious and effective courses of action to address identified needs. This draft document has been prepared by the Resources Agency to suggest a strategy by identifying solutions that consider the wide range of environmental, economic and social factors. These factors vary from the need to protect public health and safety, marine life and associated habitats, and recreational uses and facilities, to providing full consideration of the rights of public and private property owners along the coast.

This ***Draft Review of California's Coastal Erosion and Planning Response: A Strategy for Action*** (Draft Strategy) includes background material describing historic trends, the economic value of beaches, methods for managing erosion, and jurisdictional considerations. Recommendations are then made for a comprehensive approach for the state to pursue when addressing coastal erosion and beach loss along the California coast, including general guiding principles and specific actions. These recommendations will have no force or effect unless they are adopted through any number of approaches, including a coordinated, multi-department rulemaking process pursuant to the Administrative Procedures Act, an executive order, or legislative action.

This Draft Strategy would apply to developing, authorizing or reviewing public and private projects, commenting on permit actions or environmental documents, or virtually any construction, planning, permit, or funding activity that may impact coastal processes or the supply of sand to California beaches. While this document proposes a recommended strategy and associated actions, it does not in itself impose any new legal requirements or regulations.

A prior version of this document was released in March 2001 as the ***Draft Policy on Coastal Erosion Planning and Response and Background Material.*** Six public workshops were held along the California coast and one at the State Capitol in Sacramento to help improve upon the first statewide policy statement on shoreline erosion released by the Resources Agency in over 23 years. This latest version was prepared based on the extensive public comment received in writing and during the public workshops.

II. BACKGROUND

Historic Trends

In many places where the California coastline is actively eroding, substantial economic losses have occurred. Every coastal area has its own unique history of erosion events. Between the mid-1940s and the mid-1970s, California experienced an extended period of mild weather, which was accompanied by intense development in high hazard coastal areas. In the mid-1970s, these relatively mild weather patterns shifted to a period of increased storm activity. The storms of January 1988 and the El Niño winters of 1977-78, 1982-83 and 1997-98 are the most notable in recent history for intensity and widespread damage. The 1982-83 El Niño episode, the strongest ever recorded in California, caused over $116 million in coastal losses, destroyed 33 homes, damaged another 3000 homes and 900 businesses, and caused $35 million in damages to public recreational facilities (Flick and Cayan 1984). Many of these costs to public and private property owners could have been greatly reduced if development was not sited in areas of high geologic hazard, thereby reducing the call for government relief and expensive remediation.

The Economics of Beaches and Other Ocean-Dependent Industries

An economic analysis conducted by the California Research Bureau for the Resources Agency determined that ocean-dependent tourism directly and indirectly contributed $9.9 billion to the State's economy in 1992. A study prepared for the California Department of Boating and Waterways by the Public Research Institute (PRI) reports that residents and out-of-state visitors made over 565 million visits to the state's ocean beaches during 1995 alone (King and Potepan 1997). Another PRI report found that direct spending at beaches, through both tourism and recreation, contributed over $14 billion to the state's economy in 1998 (King 1999).

Conserving and maintaining these resources that provide substantial economic benefits to California and the nation requires investment by numerous partners, including federal, state and local governments. There are a variety of cost-sharing agreements that are used for coastal projects that involve partnerships between two or three levels of government. Depending upon the type of project, the minimum local government contribution for joint state and local coastal erosion impact reduction projects varies from 0% to 25%. The minimum local government contribution for joint federal, state, and local projects ranges from 0% to 25%, while the minimum contribution from the state ranges from 25% to 50%.

These cost-shared projects must compete with a vast array of other government priorities and it is therefore important to ensure that expenditures are made on the most effective and efficient solutions to coastal erosion issues. Accordingly, it is imperative that the State of California provide the necessary policy guidance to help establish a more consistent, coordinated and proactive approach to coastal erosion and beach loss.

Other Values Related to Beaches

The benefits of California's beaches are numerous and include:

- ***The recreational and aesthetic values of a wide sandy beach***. California's coastal areas provide human inspiration, spiritual renewal and irreplaceable statewide recreational and educational opportunities.

- ***The considerable contribution of beaches to the California and national economies.*** California beaches inject billions of dollars into the economy through recreation and tourism.

- ***The habitats provided for beach-dependent wildlife.*** California beaches provide important habitats for native, threatened, and endangered species such as birds (Brown Pelican, California least tern, Western snowy plover), turtles (Pacific green sea turtle) and fish (tidewater goby).

- ***Improved public safety and access to the sea***. Beaches, dunes, bluffs and other physical coastal features provide a safety buffer between the ocean and our coastal

communities, thus reducing storm damage to public infrastructure, private development and important habitats. They also provide recreational access to the sea by millions of Californians and visitors to the state.

III. MINIMIZING HAZARDS FROM COASTAL EROSION

There are three primary management strategies that may be used to plan for and respond to coastal erosion: hazard avoidance, relocation, and coastal protection. The maximum potential efficacy and acceptability of these strategies can best be determined with multi-disciplinary project planning, design, monitoring and evaluation.

Hazard Avoidance – A Commonsense Approach

The most logical method for preventing potential damage to new public or private development in the coastal zone is to not build where coastal erosion will impact such development. This concept, known as hazard avoidance, could circumvent many subsequent permitting and legal challenges. Hazard avoidance has proven effective when used in a number of ways:

- Designing public infrastructure to discourage development in high geologic hazard areas along the coast.
- Creating construction setbacks to reduce the risk to structures in the vicinity of high geologic hazard areas that may be vulnerable to damage.
- Creating tax and other economic incentives when viable, to encourage potential developers to avoid high geologic hazard areas.
- Requiring full disclosure rules on real estate transactions in high geologic hazard areas.
- Acquiring and conserving undeveloped coastal property in high geologic hazard areas.

The potential adverse impacts of continuing to place hard protection devices along the coast have been well documented. For this reason, attempts have been made to limit the use of hard protection devices to only those purposes provided for in the California Coastal Act, which states:

> Revetments, breakwaters, groins, harbor channels, seawalls, cliff retaining walls, and other such construction that alters natural shoreline processes shall be permitted when required to serve coastal-dependent uses or to protect existing structures or public beaches in danger from erosion and when designed to eliminate or mitigate adverse impacts on local shoreline sand supply. Existing marine structures causing water stagnation contributing to pollution problems and fishkills should be phased out or upgraded where feasible (Public Resources Code, Section 30235).

Relocation – Moving Development Out of Harm's Way

In some instances development is sited in unstable, erosion-prone areas that eventually may be damaged or destroyed by natural processes acting on the coast. Relocating existing public or private development away from the erosion-prone area may be the most effective long-term option when responding to the eventual or imminent threat of damage. While relocating coastal development away from hazardous areas would be the most direct way to eliminate the risk of damage and the need for coastal protection, this response may not be technically feasible or the most cost-effective alternative from the property owner's perspective. There is often little incentive for property owners to pursue this option since they would have to fully finance the relocation of a structure. Conversely, if the structure is destroyed during a natural disaster, government or privately-held disaster assistance is often available to partially or fully cover reconstruction costs. The most common use of relocation has been for public infrastructure operated by government agencies such as the California Department of Parks and Recreation.

Another approach to consider under certain circumstances is the concept of "managed retreat," the gradual removal or movement of development from areas of high geologic hazard. In the context of coastal management, the concept of managed retreat acknowledges the natural erosive processes at work along the coastline. Rather than working against nature by artificially fixing the position of the beach, managed retreat advocates the use of many tools to allow development to move inland before erosion damage occurs. Managed retreat is not a policy of complete abandonment of the land, but rather a policy of developing (or not developing) land to avoid situations in which public safety is jeopardized and natural processes are impeded.

Managed retreat is also not one thing for all places; a number of different physical, economic and planning tools exist to implement managed retreat in different areas (Skidaway Institute of Oceanography 1985). The most effective use of managed retreat has been in areas where the future problems have been anticipated and arrangements made in advance to move development from eroding bluffs and other high geologic hazard areas. Tools for implementing managed retreat include:

- Moveable structures.
- Construction setbacks to avoid risks posed by structures located close to, or within, high geologic hazard areas.
- Rolling easements that allow structures to be developed but condition their removal to allow for natural coastal processes.
- Creating tax and other incentives when viable, to encourage property owners in high-risk areas to relocate out of harm's way.
- Full hazard disclosure rules on real estate transactions in high geologic hazard areas.
- Prohibitions against rebuilding damaged structures in high geologic hazard areas.
- Acquiring and conserving endangered or undeveloped property for conversion to public parkland.

Coastal Protection Strategies – Hard and Soft Methods

Relocation and hazard avoidance strategies address the effects of erosion on development, but do not address beach loss. In situations where hazard avoidance and relocation are not viable options, coastal protection strategies can be used to reduce the potential for beach loss and coastal erosion. There are two general types of coastal protection, hard and soft. A “hard” protection device utilizes concrete or rock in a variety of configurations to absorb or dissipate storm wave energy, generally in the form of seawalls, revetments or bulkheads. "Soft" protection primarily involves dune or beach restoration or enhancement to reduce the chances of storm waves from reaching the backshore. A hard protection device differs substantially from most soft erosion response alternatives in that it does not add sand to the system of sediment flow, as noted by the National Research Council:

> “No device, conventional or unconventional, creates sand in the surf zone. Any accumulation of sand produced by a structure is at the expense of an adjacent section of the shore. This fact distinguishes structures and other devices from beach nourishment, which addresses the basic problem in coastal erosion–the shortage of sand” (National Research Council 1995).

Soft Protection

Soft protection methods include a variety of non-structural approaches, the most common being beach nourishment. The width of beaches can be increased or maintained by depositing sand up or down the coast (depending on currents), directly on beaches, or in the nearshore waters offshore of beaches (beach nourishment). The benefits from beach nourishment can be substantial by providing wide sandy beaches for recreation, wildlife habitat, and in many cases backshore protection. Investments of millions of dollars to maintain beaches will help support billions in revenues from recreation and tourism. Challenges associated with beach nourishment include initial installation and maintenance costs, limited sand sources, difficulty in transporting and placing sand, the possibility of significant environmental effects, and complicated procedures for obtaining funding and regulatory approvals. Beach nourishment can be an effective tool, but is one that may not be technically, economically, or environmentally justified for all sites, especially those with high rates of beach erosion (National Research Council 1995). Other soft protection solutions include dune restoration or enhancement, nearshore sand berm construction, and methods to reduce bluff failures by limiting the rates of groundwater infiltration and surface water runoff.

Hard Protection Devices

Constructing a hard protection device is historically the most common approach to reducing coastal erosion and protecting development. These devices can minimize wave attack and backshore erosion and are often used to protect public infrastructure. For example, a 6,000-foot seawall in Carlsbad protects a utility corridor as well as an important north-south thoroughfare along this portion of coast. A similar example is the O'Shaughnessy seawall at Ocean Beach in

San Francisco, which has protected the Great Highway since 1929. Although these hard devices have been relatively successful, they are expensive to construct and maintain.

Hard protection devices have benefits, yet the potential adverse impacts of these structures can be substantial, including limiting public access to the shoreline, increasing erosion along adjacent areas, restricting sand input from armored bluffs, reducing public beach area with a structural footprint, and disrupting the visual character of the coast. Additionally, protection devices are sometimes constructed on an emergency basis during intense storm activity without proper engineering or appropriate materials. This can lead to eventual failure of the device and create subsequent public nuisances or hazards along the beach.

The California Coastal Act requires that new development minimize risks to life and property in areas of high geologic, flood and fire hazard, assure stability and structural integrity, and neither create nor contribute significantly to erosion, geologic instability, or destruction of the site or surrounding area or in any way require the construction of protection devices that would substantially alter natural landforms along bluffs and cliffs (CA Public Resources Code, Section 30253). Nevertheless, the Coastal Act also permits the construction of protection devices when required to serve coastal dependent uses, or to protect existing structures or public beaches in danger from erosion. If protection devices are permitted, they must be designed to eliminate or mitigate adverse impacts on local shoreline sand supply (CA Public Resources Code, Section 30235).

IV. JURISDICTION

Under state and federal laws, there are a number of agencies with responsibility to plan for and respond to coastal erosion issues. Using effective planning processes is the preferred method for reducing problems related to coastal erosion. However, there must be a mechanism for responding to coastal erosion problems when they arise. Responding to coastal erosion at the state level is the responsibility of the Department of Boating and Waterways.

- ***The Department of Boating and Waterways:*** California's primary agency responsible for working to restore eroded beaches and protect public coastal infrastructure. Sections 65 through 67.3 of the State Harbors and Navigation Code assign responsibility for studying shoreline erosion, constructing protective works, and administering state funds for the local share of federal projects to the department. Sections 69.5 through 69.9 assign responsibility to the department for administering the California Public Beach Restoration Program. The mission of the program is to preserve and protect the California shoreline by restoring and maintaining natural and recreational beach resources and minimizing economic losses caused by natural and human-induced beach erosion.

Land use planning for addressing coastal erosion is shared between multiple agencies in California. The federal Coastal Zone Management Act (CZMA) requires that state coastal management programs include a "…planning process for shoreline erosion…and restore areas that have been adversely affected by such erosion" (Section 306d.2.I. of the CZMA, as amended through PL 104-150, 1996). The California Coastal Act assigns primary responsibility for carrying out the California coastal management program to the California Coastal Commission, San Francisco Bay Conservation and Development Commission, and State Coastal Conservancy.

- ***California Coastal Commission:*** the Public Resources Code (Section 30000 et seq.) designates the Coastal Commission as the lead agency responsible for carrying out California's coastal management program by planning for and regulating development in the coastal zone consistent with the policies of the California Coastal Act. The policies of the Coastal Act deal with public access to the coast, coastal recreation, the marine environment, coastal land resources, and coastal development of various types, including energy facilities, ports, and other industrial development.

- ***San Francisco Bay Conservation and Development Commission (BCDC):*** the Government Code (Section 66600 et seq.) establishes the BCDC as the coastal management agency responsible for the San Francisco Bay-Delta portion of the coastal zone. The concerns of this agency are very similar to those of the Coastal Commission.

- ***State Coastal Conservancy:*** the Public Resources Code (Section 31100 et seq.) establishes this complement to the planning and regulatory activities of the Coastal Commission and BCDC through coastal land acquisition, resource restoration and enhancement programs. The Coastal Conservancy uses entrepreneurial techniques to purchase, preserve, improve, and restore public access and natural resources along the California coast and on San Francisco Bay.

There are additional agencies within the Resources Agency with key responsibilities related to coastline management.

- ***Department of Parks and Recreation:*** Division 5 of the Public Resources Code establishes the State Park System, with the Department of Parks and Recreation as the managing agency for the system. The department is the single largest coastal landholder and manager (approximately 25% of the coast) in California. With over 35 million annual visitors to its coastal properties, the Department of Parks and Recreation is a significant stakeholder in coastal resource management and coastal erosion policy implementation. The department's mission is to help preserve the state's extraordinary biological diversity, protect its most valued natural and cultural resources, and create opportunities for high quality outdoor recreation. In addition, the department administers grants to local governments for acquiring and developing public property for parks and recreation purposes.

- ***State Lands Commission:*** division 6 and 7 of the Public Resources Code gives jurisdiction and responsibility to the State Lands Commission for managing and protecting state-owned sovereign lands, including reversionary rights in legislatively-granted lands and the mineral resources and mineral rights in those lands. The Commission has the authority to establish the landward boundary of state sovereign lands along the ocean beach and on inland waterways. The Commission may issue leases for public or private development activities that occur on state sovereign lands, including the construction of structures, placement of materials and the dredging of minerals.

- ***Department of Fish and Game:*** as the State Trustee agency for fish and wildlife under the California Environmental Quality Act (CEQA), the department is responsible for determining the impacts to fish and wildlife for any activities related to coastline development.

Although these agencies and laws form the majority of California's coastal erosion planning and response efforts, other agencies play important roles in coastal management and must exercise their mandates and advisory functions in a consistent manner. For example, the Department of Water Resources is an agency with responsibilities related to water supply and flood control projects, both of which can potentially affect the supply of sediment to the coastline.

The federal government also maintains an interest in the state's coastal zone through a number of agencies that protect the coastal environment along the nation's 25,000 miles of coastline. Some of the key federal agencies that have jurisdiction over erosion-related activities in coastal waters include:

- ***U.S. Army Corps of Engineers (USACE):*** issues federal Clean Water Act permits for dredge and fill activities and other developments that affect navigable waters, including beach nourishment. The USACE also administers the federal shore protection program, which includes research, planning, design, construction, operation and maintenance of coastal projects, the costs of which are shared with local and state sponsors.

- ***U.S. Environmental Protection Agency:*** works closely with the USACE's Regulatory Division to enforce the Clean Water Act through the review of dredge and fill project proposals. This includes the analysis of sediment suitability for use as beach nourishment material.

- ***National Marine Fisheries Service and U.S. Fish and Wildlife Service:*** advise the USACE on potential habitat impacts of proposed dredge and fill projects, as well as other construction activities, to ensure minimal impact to sensitive habitat. The National Marine Fisheries Service is also responsible for conserving essential fish habitat and administering the Endangered Species Act of 1973.

- ***National Marine Sanctuaries:*** each of the four sanctuaries located in California (Channel Islands, Cordell Bank, Gulf of the Farallones, and Monterey Bay) operate under different management guidelines, but all are devoted to protecting marine resources within their boundaries on an ecosystem basis.

The challenge for the State of California is to seek a more consistent, coordinated and proactive approach among these jurisdictions to help address erosion of the state's coastline.

V. NEW APPROACHES TO ADDRESSING COASTAL EROSION

State and federal agencies frequently implement strategies for reducing coastal erosion and protecting coastal development on a case-by-case basis. However, the natural processes and human activities that influence coastal erosion and beach loss do not follow political jurisdictional boundaries. A regional approach to addressing coastal erosion and the reduction in sand supply, based on coastal watershed and littoral cell (a portion of coastline where sand flows in, along, and then out of an area) boundaries, may be most effective in the long-term. Coordination of federal, state, and local agency activities will be necessary to support such regional approaches.

The State of California is working with the U.S. Army Corps of Engineers (USACE), representatives of local governments, and other stakeholders to develop a California Coastal Sediment Management Master Plan (Master Plan) to systematically evaluate coastal erosion and beach loss needs. On a regional basis, the plan will focus on the inter-relationships between beaches, wetlands, ports, and flood control facilities to determine how to maximize our approaches to managing coastal sediments and reducing beach losses. Such a plan will help reduce the number of instances where these issues must be addressed at the crisis stage. The Master Plan will be used to proactively target the most appropriate future projects for addressing coastal erosion and beach loss within each regional area under study. However, this effort is currently being pursued on an ***ad hoc*** basis and is not yet a formal element of California's policy for comprehensively addressing shoreline erosion.

One vehicle available to help meet the challenges of developing a Master Plan, and to address coastal erosion issues in general, is the California Coastal Sediment Management Workgroup (CSMW), a statewide effort initiated by both the USACE and California Resources Agency in late 1999. The CSMW is the first federal, state, and local government partnership developed in California for on-going, multi-agency dialogue and interaction on statewide coastal sediment management issues, such as the use of federal, state, and local funds and project coordination. The group's goal is to facilitate regional approaches to protecting, enhancing and restoring California's coastal beaches and watersheds through federal, state and local cooperative efforts. To involve interested stakeholders, the group maintains a website

(www.spd.usace.army.mil/csmwonline/) and holds public workshops to discuss issues of concern.

The CSMW is modeled after several regional organizations dedicated to addressing coastal erosion: BEACON (Beach Erosion Authority for Clean Oceans and Nourishment, in Santa Barbara and Ventura counties), the Orange County Coastal Coalition, and the San Diego Association of Governments' (SANDAG) Shoreline Preservation Committee. These organizations provide a forum for a variety of stakeholders, including government agencies, not-for-profit organizations, and interested members of the public, to discuss issues associated with coastal erosion and beach loss. They also serve as project planning and management entities for regional projects, such as the SANDAG Regional Beach Nourishment Project and the BEACON Opportunistic Nourishment Program. Member agencies in the organizations, such as cities and counties, pool their financial and technical resources to develop beach nourishment projects that benefit entire regions.

VI. A STRATEGY FOR ACTION

The State of California is committed to conserving, restoring and enhancing California's coastline and beaches. Coastal erosion and beach loss are not issues that can be adequately addressed at only the land and sea interface; effective solutions require a comprehensive statewide approach that considers watersheds that ultimately flow to the ocean, flood control systems, ports, wetlands, beaches and nearshore ocean processes. California must move beyond a policy of case-by-case reviews of coastal erosion projects (often in crisis situations) to an approach that proactively focuses on larger scale regional issues at both the coastline and within associated watersheds.

Government responsibility for addressing coastal erosion and beach loss in particular is divided among a host of federal, state, and local agencies. Other interested parties range from private property owners and businesses to public interest groups and academia. Cooperation among these parties will be necessary to implement an effective coastal erosion planning and response action plan. The State of California must be proactive and work with all interested parties to address coastal erosion and beach loss, including wide-reaching efforts to maintain natural levels of sediment transported through coastal watersheds to the coastline. Three specific actions are recommended: adopt five general principles as state policy, amend the California Coastal Act, and require the completion of a California Coastal Sediment Master Plan within two years.

Recommendations 1: Adopt Five General Principles

The State of California should adopt as state policy a set of five general principles for addressing coastal erosion, in order of preference:

- ***Hazard Avoidance for New or Modified Development***
- ***Maintaining Natural Sources of Sediment to the Coast***
- ***Regional Beach Nourishment***
- ***Relocating or Eliminating Coastal Development Where Feasible***
- ***Hard Protection Devices***

Hazard Avoidance for New or Modified Development. Development on coastal lands subject to erosion can threaten public safety, public and private property, habitats and recreational opportunities, and should be avoided whenever possible. This guidance is already provided in state law, though not necessarily in the most effective way or in the specific context of the priorities suggested in this document. The Coastal Act requires that new coastal development minimize risks to life and property in areas of high geologic, flood, and fire hazard; assure stability and structural integrity; and neither contribute significantly to erosion, geologic instability, or destruction of the site or surrounding area or in any way require the construction of protection devices that would substantially alter natural landforms along bluffs and cliffs (CA Public Resources Code, Section 30253).

While abiding by the requirements of the Coastal Act, the Department of Parks and Recreation has adopted a stringent, internal policy of hazard avoidance and managed retreat that can be used as a model. Specifically, its shoreline erosion policy titled, ***Coastal Erosion Departmental Notice 99-18, December 28, 1999***, states:

> "The Department of Parks and Recreation shall avoid construction of new structures and coastal facilities in areas subject to ocean wave erosion, seacliff retreat, and unstable cliffs, unless specific determinations have been made that the risk of loss of the facility is offset by the investment and need for the facility. Measures shall be taken to minimize human-induced erosion by reducing concentrated surface runoff from use areas, elevated groundwater levels from irrigation and urbanization, and surface disturbance of blufftop soils. In recognition of California's actively eroding coastline, new structures and facilities located in areas known to be subject to ocean wave erosion, seacliff retreat, or unstable bluffs shall be expendable or movable. Structural protection and re-protection of developments shall be allowed only when the cost of protection is commensurate with the value (physical and intrinsic) of the development to be protected, and when it can be shown that the protection will not negatively affect the beach or the near-shore environment."

Maintaining Natural Sources of Sediment to the Coast. Projects constructed within coastal watersheds can have significant impacts on the coast by blocking the flow of sediment to the coastline. Developments planned, constructed, or authorized by state agencies within coastal watersheds should meet the following conditions:

- Whenever feasible and consistent with water quality and habitat protection requirements, the development, together with adjacent developments allowed under local or regional land use regulations, will not reduce the quality or quantity of the natural supply of sediment to the coastline.
- Whenever feasible and consistent with water quality and habitat protection requirements, the project should include measures to ensure a natural rate of sediment supply.
- The development should be consistent with any existing regional plan within the watershed in which the development is planned.

Regional Beach Nourishment. In cases where existing development is threatened, the next step is to evaluate projects that minimize or eliminate the erosion threat. A common soft protection method is beach nourishment, which is the primary method for restoring and enhancing the recreational capacity of narrowed beaches. Suitable beach nourishment material may be available from offshore dredging or onshore grading and excavation operations. If this potential beach material meets state and federal size and composition guidelines, it should be considered for beach nourishment. This Draft Strategy recommends the following criteria for evaluating the feasibility of beach nourishment approaches:

- Nourishment will not have a significant adverse effect on other areas or developments along the coast, cultural and paleontological resources, or living marine resources or their habitats.
- The nourishment program is complemented by other non-structural methods to lengthen the life of beach nourishment and reduce adjacent bluff retreat and subsequent failures, such as by reducing rates of groundwater infiltration and surface water runoff within these areas.
- Measures are included to encourage regional coordination to maximize the effectiveness of the operation within the coastline area (littoral cell) being restored or nourished.
- Sand should be deposited directly onto a beach or in the nearshore in an appropriate manner for effective beach nourishment and in a manner that protects significant natural resources and public access.
- When beach nourishment is unnecessary, infeasible or inappropriate at the time of sediment removal, the sand component of the material should be stored for eventual use for beach nourishment, provided that suitable locations are available and steps are taken to protect both significant natural resources and public access at those locations.
- In those instances where quantity, size, distribution, or composition of dredged or excavated material limits its use as described above, the value of the material should be optimized by using it as a mineral resource, construction material, or material for other forms of habitat restoration.

Relocating or Eliminating Coastal Development Where Feasible. Public or private development located in areas of high geologic hazard (often close to the ocean) can be vulnerable to severe damage or destruction during coastal storms and high wave events.

Relocating development away from an eroding beach or bluff (sometimes called managed retreat) may be the only way to preserve the development and ensure public safety. Whenever feasible the federal government, the State of California, and local governments should encourage the relocation of development from high geologic hazard areas through the use of tax or other incentives, amendments to local coastal programs, or coastal land acquisition and conservation easement programs.

***Hard Protection Devices*.** Construction of seawalls, revetments, breakwaters, groins, or other artificial rigid devices for coastal erosion control should be limited to cases where no other non-structural alternative is effective or feasible to reduce erosion hazards to the protected development and each of the following conditions are met:

- The project is to serve a coastal dependent use, protect an existing structure, or enhance or protect a public beach in danger from erosion.
- A report by a registered and licensed engineering geologist demonstrates that an existing structure, a coastal dependent use, or a public beach is at risk from coastal erosion. Further, conclusive evidence is presented in a report by a registered and licensed engineering geologist that the proposed protection device is designed and can be constructed and maintained to withstand the specified design criteria that reflect the range of conditions that exist at the project site, and will successfully mitigate the effects of coastal erosion while minimizing the significant effects of the project on other sections of the shoreline. Evidence is also presented that the proposed structure will not cause erosion of adjacent properties, thus potentially leading to further hardening of the coastline.
- The project is consistent with the erosion solutions presented in the certified local coastal plan or other regional coastal management plan that identifies and comprehensively addresses regional coastal hazard issues.
- The project will not have a significant adverse effect on other areas or developments along the coast, cultural and paleontological resources, or living marine resources or their habitats.
- There will be no net reduction in public access to, and use and enjoyment of, the natural coastal environment, and construction of a protection device will preserve, enhance or provide access to related public recreational lands or facilities.
- Measures are included to ensure that the protection device can and will be maintained to fulfill its intended purpose and to specify the removal of the protection device if the device fails to function as designed, is not maintained, or is no longer necessary.
- When appropriate, other non-structural measures are included that will complement the use of the hard protection device, such as beach nourishment.

These general principles identify a hierarchy of approaches that should be used by government agencies and others working to address coastal erosion in California. Currently, most of these principles can be inferred from existing law, and many are even explicitly required in statute.

However, there is no single, comprehensive and mandatory set of procedures to guide California's approach to coastal erosion. Regulatory, planning, construction, or funding issues related to coastal erosion are regularly addressed by as many as nine state agencies, six federal agencies and a host of local governments – often on a case by case basis. The existing body of law and policy is fragmented and needs to be amended to implement the comprehensive approach recommended in this Draft Strategy.

Recommendation 2: Amend the California Coastal Act

The State of California should amend the California Coastal Act to clarify the use of hard protection devices. Per the Coastal Act, hard protection devices should be allowed in only very limited circumstances, such as protecting existing structures. However, the Coastal Act currently allows for substantial interpretation regarding the concepts of minimizing risks; defining "existing" structures, stability and structural integrity, and significant contribution to erosion or geologic instability; and whether a hard protection device might be required in the future. Clearer standards for determining that a proposed development meets the conditions of the Coastal Act could prove beneficial to decision-makers as well as those wishing to develop coastal properties.

Specifically, the definition and interpretation of the term "existing structure" used in the Coastal Act needs clarification as it relates to the approval of hard protection devices. The Coastal Act does not identify at what point in time a structure developed along the coast becomes an "existing structure." A new structure approved by the Coastal Commission is considered an existing structure once constructed, and would therefore be eligible for a hard protection device in the future. For new construction this leads to a disincentive for avoiding hazards because current law is interpreted to allow a hard protection device if that "existing structure" is "in danger from erosion" at some future date.

Recently the Coastal Commission has been placing permit conditions, signed by applicants, on new construction along the coastline indicating that the applicant will not pursue the approval of a hard protection device in the future. A long-term approach may be to clarify the Coastal Act to prohibit or restrict the approval of hard protection devices for structures constructed after a date specified in the statute. This clarification could begin to reduce the construction of new hard protection devices along the California coast.

Recommendations 3: Complete a Coastal Sediment Management Master Plan

The State of California should require the Department of Boating and Waterways, California Coastal Commission, and California Coastal Conservancy, in cooperation with the U.S. Army Corps of Engineers and interested parties, to complete a California Coastal Sediment Management Master Plan within two years. The most effective way for California to address the impacts of coastal erosion is to seek to comprehensively understand and manage the sediments in coastal watersheds and along the coastline. The foundation for establishing more effective and proactive coastal sediment management is to develop a California Coastal Sediment

Management Master Plan (Master Plan). The key to developing and implementing this comprehensive approach will be for all levels of government, the public, academia and the private sector to collaborate through an extensive public outreach effort. To meet the needs of California in the 21st Century, these interests must work together to assess the condition of California's coastline and coastal watersheds, in addition to identifying ongoing or planned regional efforts to manage sediment.

Consistent with the general principles identified in this Draft Strategy, the input of individuals and organizations intimately familiar with a particular area will be critical to identifying relevant information sources, historical site conditions and erosion response activities, and potential opportunities for collaboration. In developing the Master Plan, input should be sought from these groups through a series of regional workshops held along the coast to fully understand regional needs and site conditions. The Master Plan should provide the basis for evaluating and prioritizing strategies to protect public health and safety, marine life, habitat, and recreational uses, while also protecting the rights of public and private property owners. On a regional basis, the Master Plan should identify, describe, evaluate and prioritize sediment management approaches to restoring, enhancing and maintaining high priority coastal beaches, wetlands, and watersheds. The Master Plan should be used to help guide future sediment management investments.

It is through this type of comprehensive effort that we can begin to develop more effective approaches to coastal erosion and beach loss, particularly in light of the long-term phenomenon of sea level rise and the cyclical nature of events such as El Niño. Coordination with key federal agencies such as the Environmental Protection Agency, Army Corps of Engineers, National Marine Fisheries Service, and National Marine Sanctuary Program will be critical to the success of this effort.

While the development of such a plan has received funding to begin the process, it is an ***ad hoc*** effort organized by the Resources Agency, its departments, and the U.S. Army Corps of Engineers. This effort is not yet a formal element of California's policy for comprehensively addressing shoreline erosion. In addition, California needs to formally request financial assistance from and participation by federal agencies for completing elements of the Master Plan and for its long-term maintenance. There are seven key elements the Master Plan should contain.

Identify, on a regional basis, the coastal areas most threatened by erosion and other geologic hazards. Historically it has been difficult to identify the highest priority objectives for federal, state, and local investment in responding to coastal erosion. The Master Plan can play an important role in this process by identifying, on a regional basis, the coastal areas most threatened by erosion and geologic hazards. This analysis can play a critical role in setting goals at all levels of government to initiate the comprehensive actions necessary to respond to these areas.

Identify regional strategies for addressing these threatened coastal areas, consistent with the general principals identified above. Geologic hazards and risks associated with development vary considerably along the California coast. What may be a hazard or risk in one region may be completely different in another which requires that regional strategies be developed that are tailored to the conditions existing within each region. Therefore, each region included in the master plan should include an assessment of the most appropriate regional approaches to address the areas threatened by erosion and other geologic hazards.

Identify and assess the adequacy of existing legal and planning measures at all levels of government to address these threatened areas, as well as to respond to other sediment management issues in each region. The regional assessment should identify whether existing planning and regulatory tools are sufficient to address the threats identified. Specifically, this analysis should address the following questions:

1. Are effective land use plans and regulations in place, including hazard-based coastal construction setback zones, to reduce the vulnerability of existing and future development to beach and coastal erosion, seasonal beach fluctuations, coastal flooding, and other natural events?

2. Are measures being taken to control surface runoff, groundwater infiltration, and other processes that contribute to bluff and slope instability?

3. Are procedures in place for the orderly demolition or relocation of damaged, hazardous, or threatened development and for the disposition of parcels of land that cannot safely be developed?

Identify, catalogue, and help provide access to relevant information sources for each region. Numerous government agencies and interested organizations host a great deal of information and data related to this regional assessment, but this information has not been identified and integrated into consistent and usable formats. These valuable resources should be identified and evaluated for inclusion in web-based mapping and geographic information system products as part of developing a Master Plan.

Develop clear scientific standards for the beneficial use of sediments to support beaches. Scientific standards or parameters should be developed to guide the beneficial use of available sediments for beach nourishment projects. Key components should include:

Oceanographic conditions: identify the oceanographic conditions necessary for successful beach nourishment projects.

Sediment grain size: identify the appropriate mix of sediment grain sizes for successful nourishment. The beneficial reuse of sediments on a beach or in the nearshore environment

can improve the beach area, but legitimate concerns exist regarding turbidity resulting from the suspension of the fine-grained portion of the disposal sediment. Other concerns are raised with the fate of coarse-grained sediment that generally remains close to shore.

Marine life and habitat: identify the criteria for assessing acceptable impacts to marine life and habitat from these projects, particularly regarding the impacts of these operations to hard bottom habitats.

Identify research necessary to apply state-of-the-art methods to address coastal erosion. Responding to coastal erosion requires the expenditure of millions of dollars each year by government agencies, industry, and individuals to protect both public and private development. To be most effective and to maximize the use of funds used for coastal erosion prevention and response, the State of California should support long-term planning and research studies to determine the most effective techniques for addressing coastal erosion, and to assess their environmental impact. For example, ongoing studies by the Scripps Institution of Oceanography are helping to determine where sand travels after a beach is nourished, what factors are most influential in this movement, and how to improve the prediction of the best conditions for nourishment. This information is critical if future projects are to achieve their intended purpose in a cost-effective way.

Identify ways to maximize the benefits of California's fiscal participation in addressing coastal erosion. An important underlying element to the identified principles and recommended actions is to maximize the benefits of the state's participation in regional coastal erosion prevention and response projects. Preventing the need for expensive "after-the-fact" approaches is key to achieving this goal. The Master Plan should help guide State participation (financial or otherwise) in regional coastal erosion projects that will facilitate pro-active solutions that maximize public benefits, reduce environmental impacts, and hopefully maximize the return on investment.

VII. MOVING FORWARD

It is clear that California has the ability to shape the way new development is sited along the coast and to avoid mistakes of the past. Using the strategies identified in this document, California can begin the long-term process of re-establishing natural sources of sediment to the coast, as well as pursue regional processes for intervening along the shoreline when necessary.

This Draft Strategy envisions a comprehensive approach to shoreline erosion never before attempted in the State of California. Establishing clear statewide priorities for approaching California coastal erosion and clarifying certain Coastal Act policies, combined with developing a progressive Coastal Sediment Management Master Plan will help California face future

challenges. By necessity this will bring federal, state, and local agencies and other stakeholders together to pursue a common vision, yet there is no panacea presented in these recommendations. New management approaches cannot eliminate sea level rise, El Niño storm activity, or the natural process of sediment movement and erosion along our shoreline. The fact is that there are existing structures and coastal dependent facilities (including some critical infrastructure) currently located in high geologic hazard areas along the California coastline, and tough decisions will have to be made regarding their protection.

Interest in moving forward with this Draft Strategy appears to be significant, based on the volume of written comments received and the interest expressed at workshops conducted at many coastal locations, from Trinidad in Northern California to Encinitas in Southern California. Implementation of the recommendations, when finalized, will be based on the most effective approaches determined to be suitable at that point in time, but may include a rulemaking process pursuant to the Administrative Procedures Act, an executive order, or new legislation. Irrespective of the method or methods chosen for implementation, ultimate success will depend upon a coordinated and cooperative approach by all interested parties.

DEFINITIONS

beach	A deposit of non-cohesive material (e.g. sand, gravel) situated on the interface between dry land and the sea (or other large expanse of water) and actively "worked" by present-day hydrodynamics processes (i.e. waves, tides and currents) and sometimes by winds (Voigt 1998).
coast	A strip of land of indefinite length and width (may be tens of kilometers) that extends from the seashore inland to the first major change in terrain features (Voigt 1998).
coastal-dependent use	Any development or use which requires a site on, or adjacent to, the sea to be able to function at all (CA Public Resources Code, Section 30101).
coastal watershed	A geographic area in which all sediments, dissolved materials, and sources of water, including lakes, rivers, estuaries, wetlands, and streams, as well as ground water, drain to a sea or ocean (adapted from the US EPA Office of Water, Publication EPA 842-F-98-006, "Your Coastal Watershed").
coastal zone	The land and water area of the State of California from the Oregon border to the border of the Republic of Mexico, specified on the maps identified and set forth in Section 17 of that chapter of the Statutes of the 1975-76 Regular Session enacting this division, extending seaward to the state's outer limit of jurisdiction, including all offshore islands, and extending inland generally 1,000 yards from the mean high tide line of the sea. In significant coastal estuarine, habitat, and recreational areas it extends inland to the first major ridgeline paralleling the sea or five miles from the mean high tide line of the sea, whichever is less, and in developed urban areas the zone generally extends inland less than 1,000 yards. (CA Public Resources Code, Section 30103 (a))
coastline	(1) The line that forms the boundary between the coast and the ocean; (2) the line where terrestrial processes give way to marine processes, tidal currents, wind waves, etc. (Voigt 1998).
development	"'Development' means, on land, in or under water, the placement or erection of any solid material or structure; discharge or disposal of any dredged material or of any gaseous, liquid, solid, or thermal waste;

	grading, removing, dredging, mining, or extraction of any materials; change in the density or intensity of use of land, including, but not limited to, subdivision pursuant to the Subdivision Map Act (commencing with Section 66410 of the Government Code), and any other division of land, including lot splits, except where the land division is brought about in connection with the purchase of such land by a public agency for public recreational use; change in the intensity of use of water, or of access thereto; construction, reconstruction, demolition, or alteration of the size of any structure, including any facility of any private, public, or municipal utility; and the removal or harvesting of major vegetation other than for agricultural purposes, kelp harvesting, and timber operations which are in accordance with a timber harvesting plan submitted pursuant to the provisions of the Z'berg-Nejedly Forest Practice Act of 1973 (commencing with Section 4511).” As used in this section, "structure" includes, but is not limited to, any building, road, pipe, flume, conduit, siphon, aqueduct, telephone line, and electrical power transmission and distribution line. (CA Public Resources Code, Section 30106)
feasible	Capable of being accomplished in a successful manner within a reasonable period of time, taking into account economic, environmental, social, and technological factors (CA Public Resources Code, Sections 21061.1 and 30108).
hazard	An event or physical condition that has the potential to cause fatalities, injuries, property damage, infrastructure damage, agricultural loss, damage to the environment, interruption of business or other types of harm or loss (NOAA Coastal Services Center 2002)
risk	The potential for losses associated with a hazard, defined in term of expected probability and frequency, causative factors and locations/areas affected (NOAA Coastal Services Center, 2002).
shoreline	The line where a body of water and the shore meet (Webster's Collegiate Dictionary, 10th Edition).
significant effect	A substantial, or potentially substantial, adverse change (CA Public Resources Code, Section 21068).

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